



Management and Monitoring

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Agenda

- Monitoring
 - JDK tools, System tools, WildFly specifics
- WildFly history and overview
- WildFly 10
 - Architecture, Domain Model, RBAC
- WildFly Swarm
- WildFly 10 Management
 - CLI / Scripting + Java API + HTTP API
 - WebUI
- RHQ, Hawkular
- Openshift



Monitoring – motivation

You are using WildFly 10, so bright future lies ahead ...

Really?

We will learn how to do some basic investigation and JVM monitoring.



JDK tools - JAR level investigation

- List files in given jar archive
 - jar
 - unzip
- Disassemble the class file
 - javap



JDK tools – process

- List of JVMs
 - `jps -l [-m -v]`
 - JDK specific



JDK tools – memory

- Memory map
 - jmap
 - Show heap, create heap dump
- Analyze heap dump
 - jhat
 - Parses a java heap dump, launches a webserver to browse the dump



JDK tools – stack trace and JVM stats

- Java stack traces of threads
 - jstack
 - stack traces of Java threads for a given Java process, core or remote server
 - for investigating thread locking issues
- JVM statistics monitoring
 - jstat



JDK tools – GUI

jconsole

- Heap and Non-Heap memory usage, CPU usage, VM summary
- Number of threads and classes, stack trace for each thread
- MBeans details

VisualVM (jvisualvm before)

- Nicer look & feel, based on NetBeans platform
- Heap and PermGen memory usage, CPU usage, VM summary
- Number of threads and classes, details for each thread, not stack trace
- Lightweight CPU and memory profiling + sampling



System information

- OS version
- Memory usage
- Disk space
- Processes
- Network – traffic and ports



WildFly specifics

JDR - JBoss Diagnostic Reporter

- `$WF_HOME/bin/jdr.sh` [.bat]
- JBoss specific tool for diagnostic
- add at least one user into ManagementRealm using `bin/add-user.sh`

jconsole

- `$WF_HOME/bin/jconsole.sh` [.bat]
- Jconsole with added WildFly management extension (JBoss Remoting + JSR 160)



Advanced tools

- your IDE debugger
- your IDE profiler
- JProfiler - <http://www.ej-technologies.com/products/jprofiler/overview.html>
- Java Decompiler - <http://java.decompiler.free.fr/>
- TDA - Thread Dump Analyzer - <http://java.net/projects/tda/>
- MAT - Memory Analyzer - <http://www.eclipse.org/mat/>

- Wireshark - <http://www.wireshark.org/>



WildFly history and overview

- Named JBoss AS before
- Why was AS7 rewritten from scratch?
 - Legacy subsystems
 - Boot time
 - Memory footprint
 - Bad modularity
 - Administration options
 - Not “good enough”



WildFly history and overview

- Wildfly 8
 - Builds on top of JBoss AS7
 - Small and even #@*%ing faster
 - No legacy stuff
 - Better manageability
 - Multi-node management
 - Simplified configuration
 - Modular



WildFly history and overview

- Wildfly 9
 - HTTP/2 Support
 - Front End Load Balancer Support
 - Graceful Shutdown
 - WildFly Swarm
- Wildfly 10
 - Java 8+
 - ActiveMQ Artemis
 - JavaScript Support with Hot Reloading



WildFly 10 Architecture

- **core**
- **extensions** to the core
- **clients** for management interface
 - CLI and web based management console



Core

- jboss-modules
 - is the first thing started
 - modular and concurrent classloading
 - $O(1)$ dependencies resolution
 - Module sees only its imports
- jboss-msc: modular service container
 - Everything is (interface based) service
 - Services are deployed on demand and in parallel
- Extensible management layer
 - Mediate access to service container
 - Provides configuration model for the AS



Domain vs. standalone

Standalone

- Traditional JBoss single JVM server
- Managed individually: 1 configuration file
- No lifecycle management, just shutdown
- Development and embedded solutions

Domain

- Multi-JVM, multi-server model
- Lifecycle managed by Process Controller (PC)
- Management coordinated by Domain Controller (DC)
- Multiple server instances per host managed by Host Controller (HC)
- HC on master node is DC

The only difference between domain and standalone is in how servers are managed, not in the capabilities

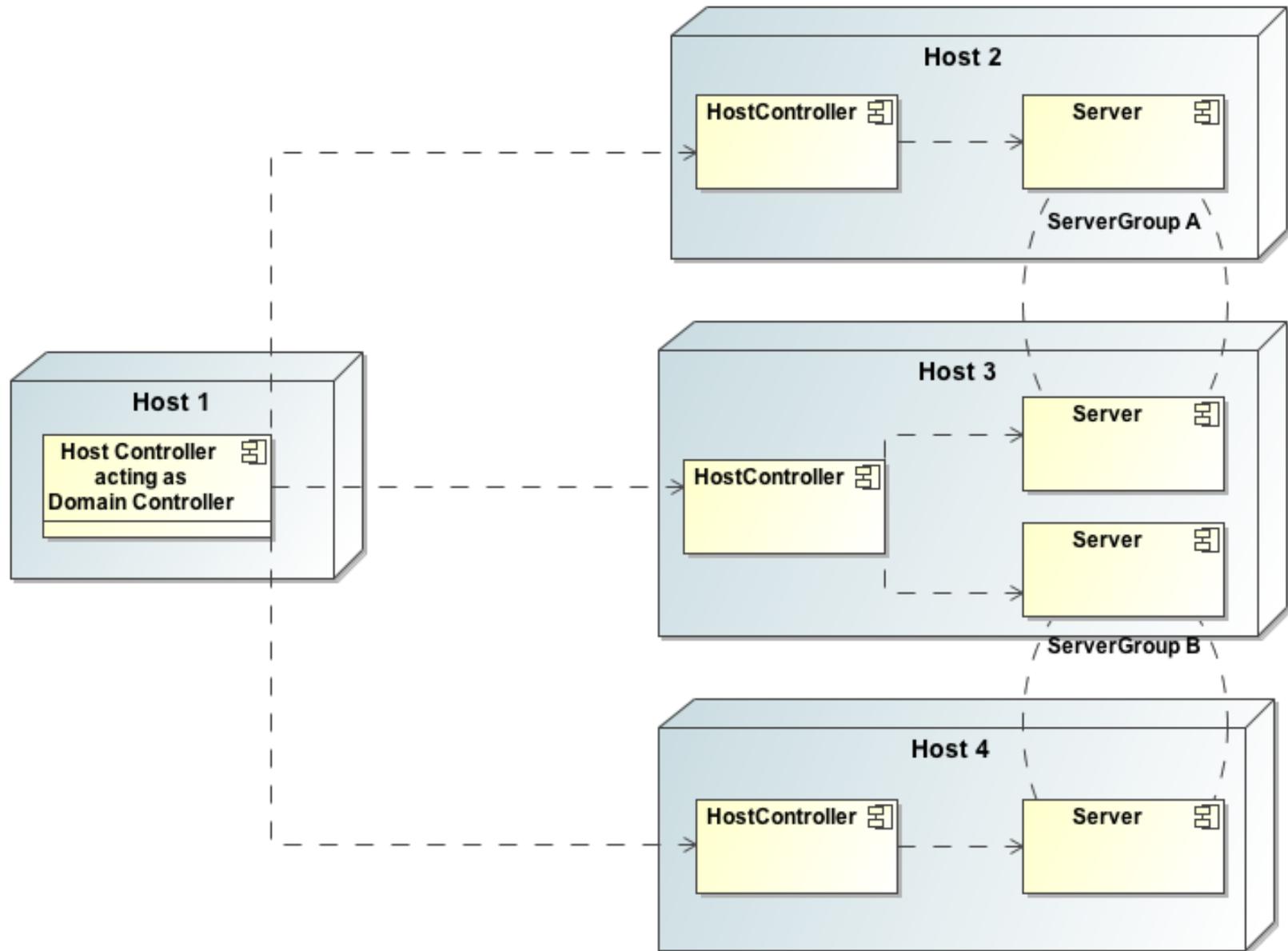


Domain model: key goals

- manage multiple servers via a single control point
 - configure a cluster, start/stop nodes in a cluster, deploy an application to all nodes in the domain,...
- end user configuration centralized in a few files
- schema files for all configurations
- everything in the configuration is exposed via management API



Domain model



Domain model - terms

- **server** - one AS instance
- **server group** - set of server instances that will be managed and configured as one
- **cluster** - server group with group communication services configured
- **module** - classloading space, grouping of classes in some jar(s)
- **subsystem** - block of configuration, has its own namespace, basically some grouping of services
- **profile** - set of subsystems



Role Based Access Control (RBAC)

- Different users have different sets of permissions to read and update parts of the management tree
- Replaces the simple permission scheme used in JBoss AS 7, when authenticated user have all permissions
- **Role** - named set of permissions (read, modify management resource
- Mapping users and groups to roles
- <https://docs.jboss.org/author/display/WFLY10/RBAC>



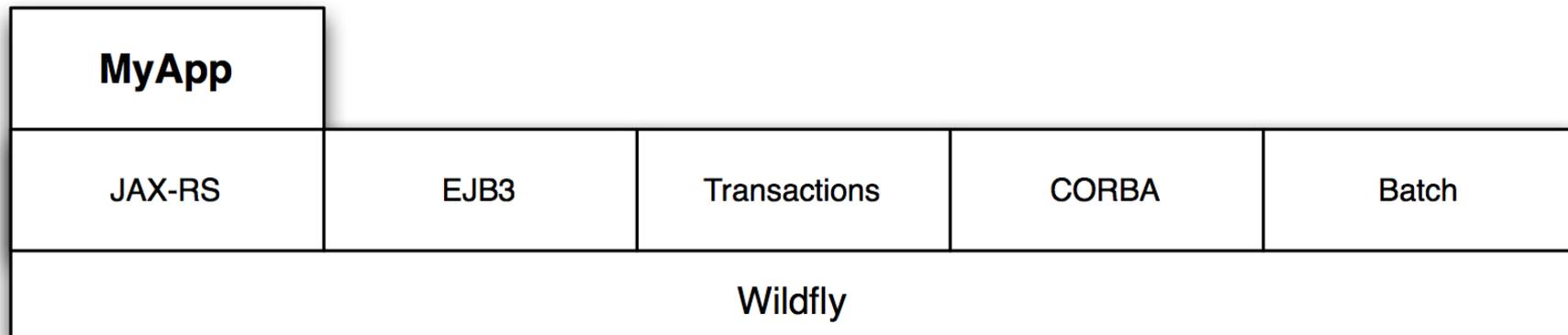
RBAC roles

- Not given permissions for "security sensitive" items:
 - **Monitor** – read only
 - **Operator** – Monitor + modify runtime state
 - **Maintainer** – Operator + modify persistent config.
 - **Deployer** – Operator + modify "application resources"
- Given permissions for "security sensitive" items:
 - **SuperUser** – all permissions (== JBoss AS 7 admin)
 - **Administrator** – all permissions except cannot read or write resources related to the administrative audit logging system
 - **Auditor** – can read anything. Can only modify the resources related to the administrative audit logging system.

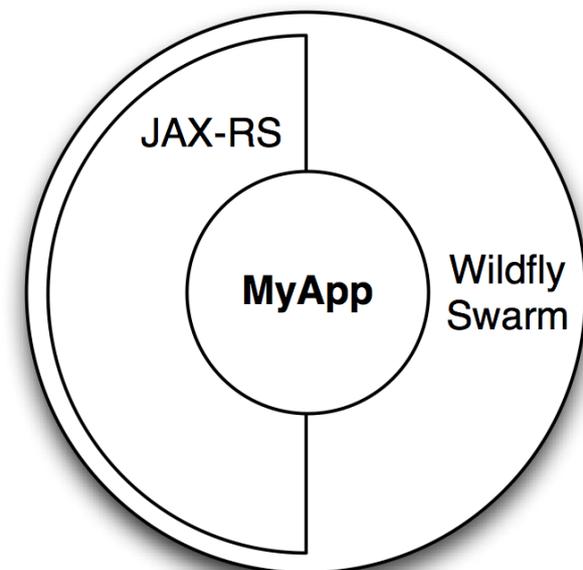


WildFly Swarm

- Monolithic App server
 - Traditional model – more functionality than needed



- WildFly Swarm Uberjar
 - Just enough app server
 - Smaller usage of resources
 - Microservices



WildFly Swarm

- Fraction
 - well-defined collection of capabilities to add, (in most cases maps directly to WF subsystem)
- Uberjar
 - A self-contained, executable Java archive
- Requires JDK 8+
- Maven
- <http://wildfly-swarm.io>

```
<dependency>  
  <groupId>org.wildfly.swarm</groupId>  
  <artifactId>jaxrs</artifactId>  
</dependency>
```

```
<plugin>  
  <groupId>org.wildfly.swarm</groupId>  
  <artifactId>wildfly-swarm-plugin</artifactId>  
  <executions>  
    <execution>  
      <goals>  
        <goal>package</goal>  
      </goals>  
    </execution>  
  </executions>  
</plugin>
```

```
java -jar MyApp-swarm.jar
```



Management

- The problem: management model too large and complex
- The requirements for the API:
 - Simple, powerful, stable
 - As few compile time and runtime dependencies as possible
 - Backward compatibility
- WF uses de-typed management API and a small library:
jboss-dmr.jar



DMR – dynamic model representation

- <https://github.com/jbossas/jboss-dmr>
- <https://docs.jboss.org/author/display/WFLY10/Detyped+management+and+the+jboss-dmr+library>
- All management operations operate with/on DMR
- Compatibility is stressed
- Convertible from/to JSON

- Wildfly Model Reference Documentation:
 - <https://wildscribe.github.io/index.html>



Java API

- Native management interface uses an open protocol based on the JBoss Remoting library
- The management protocol is an open protocol, so a completely custom client could be developed without using prepared libraries (e.g. using Python or some other language)
- Maven artifact `org.wildfly.core:wildfly-controller-client`
- <https://docs.jboss.org/author/display/WFLY10/The+native+management+API>



Java API

```
ModelControllerClient client = ModelControllerClient.Factory.  
    create(InetAddress.getByName("localhost"), 9999);
```

```
ModelNode op = new ModelNode();  
op.get("operation").set("read-resource");  
op.get("recursive").set(true);  
op.get("include-runtime").set(true);  
op.get("recursive-depth").set(10);
```

```
ModelNode returnVal = client.execute(op);  
System.out.println(returnVal.get("result").toString());  
client.close();
```



HTTP API

- <http://localhost:9990/management>
- Sometimes called REST API
- HTTP request in JSON like format
- The default operation is read-resource
- add user into ManagementRealm using `bin/add-user.sh`

- <https://docs.jboss.org/author/display/WFLY10/The+HTTP+management+API>
- <https://community.jboss.org/wiki/HTTPJSON-likeAPI>



CLI

- Command line management tool for the WF server
- Command `bin/jboss-cli.sh` or `bin/jboss-cli.bat`
- Interactive mode
- Non-interactive mode
- Batch mode
- GUI mode
- Operations based on model



CLI

```
$ ./bin/jboss-cli.sh --connect controller=IP_ADDRESS
[standalone@IP_ADDRESS:9999 /] /system-property=foo:add(value=bar)
[standalone@IP_ADDRESS:9999 /] /system-property=foo:read-resource
{
  "outcome" => "success",
  "result" => {"value" => "bar"}
}
[standalone@IP_ADDRESS:9999 /] /system-property=foo:remove
{"outcome" => "success"}
```

```
[domain@IP_ADDRESS:9999 /] /system-property=foo:add(value=bar)
[domain@IP_ADDRESS:9999 /] /system-property=foo:read-resource
[domain@IP_ADDRESS:9999 /] /system-property=foo:remove
```

```
[domain@IP_ADDRESS:9999 /] /host=master/system-property=foo:add(value=bar)
[domain@IP_ADDRESS:9999 /] /host=master/system-property=foo:read-resource
[domain@IP_ADDRESS:9999 /] /host=master/system-property=foo:remove
```

```
[domain@IP_ADDRESS:9999 /] /host=master/server-config=server-one/system-property=foo:add(value=bar)
[domain@IP_ADDRESS:9999 /] /host=master/server-config=server-one/system-property=foo:read-resource
[domain@IP_ADDRESS:9999 /] /host=master/server-config=server-one/system-property=foo:remove
```



CLI

- <https://community.jboss.org/wiki/CommandLineInterface>
- <https://community.jboss.org/wiki/GenericTypeCLICommands>
- <https://community.jboss.org/wiki/CLICompoundValueFormat>
- <https://community.jboss.org/wiki/CLINon-interactiveMode>
- <https://community.jboss.org/wiki/CLIBatchMode>
- <https://docs.jboss.org/author/display/WFLY10/CLI+Recipes>



Web console

The screenshot displays the WildFly web console interface. At the top, there is a navigation bar with tabs for Home, Deployments, Configuration, Runtime, Access Control, and Patching. The user's name 'ferda' and 'Messages: 0' are visible in the top right corner. The main content area is divided into several sections, each with an icon and a title:

- Deployments**: Add and manage deployments. Includes a 'Deploy an Application' link and a 'Start' button. Below, it says 'Deploy an application to the server' and lists two steps: 1. Use the 'Add Deployment' wizard to deploy the application; 2. Enable the deployment.
- Configuration**: Configure subsystem settings. Includes a 'Create a Datasource' link and a 'Start' button. Below, it says 'Define a datasource to be used by deployed applications. The proper JDBC driver must be deployed and registered.' and lists three steps: 1. Select the Datasources subsystem; 2. Add a Non-XA or XA datasource; 3. Use the 'Create Datasource' wizard to configure the datasource settings. There is also a 'Create a JMS Queue' link and a 'Start' button.
- Runtime**: Monitor server status. Includes a 'Monitor the Server' link and a 'Start' button. Below, it says 'View runtime information such as server status, JVM status, and server log files.' and lists two steps: 1. Select the server; 2. View log files or JVM usage.
- Access Control**: Manage user and group permissions for management operations. Includes an 'Assign User Roles' link and a 'Start' button. Below, it says 'Assign roles to users or groups to determine access to system resources.' and lists two steps: 1. Add a new user or group; 2. Assign one or more roles to that user or group.
- Patching**: Manage WildFly patches. Includes an 'Apply a Patch' link and a 'Start' button. Below, it says 'Apply a WildFly patch to the server.' and lists two steps: 1. Download the patch file to the local machine; 2. Use the 'Apply Patch' wizard to select and apply the patch.
- Need Help?**: A section with a question mark icon, containing two columns of links. The first column includes 'General Resources' with links to WildFly Home, WildFly Documentation, Admin Guide, Model Reference Documentation, Browse Issues, and Latest News. The second column includes 'Get Help' with links to Access tutorials and quickstarts, User Forums, IRC, and Developers Mailing List.

At the bottom left, the version '10.0.0.Final' is displayed. At the bottom right, there are links for 'Tools' and 'Settings'.



RHQ

- RHQ is an enterprise management solution for JBoss middleware projects, Tomcat, Apache Web Server, etc.
- Server-side and agent-side (extendable via plugins)
- Features
 - Inventory – tracking resources (autodiscovery)
 - Configuration – audited, rollback
 - Monitoring – collection of statistics
 - Alerts – to provide notifications of user defined conditions
 - Operations – ability to execute actions against managed resources in the inventory
- <https://rhq-project.github.io/rhq/>



RHQ
★ 0 | 👤 rhqadmin

Dashboard | Inventory | Reports | Bundles | Administration | Help

Edit Mode | New Dashboard

Message
⌵ ⌵ ⌵ ⌵

Welcome to RHQ

This dashboard can be edited by clicking the (Edit Mode) button above.

What would you like to do?

[Import newly discovered resources.](#)

[Search for resources.](#)

[See help and documentation.](#)

Inventory Summary
⌵ ⌵ ⌵ ⌵

Platform Total :	2
Server Total :	14
Service Total :	842
Compatible Group Total :	7
Mixed Group Total :	1
Group Definition Total :	5
	--

Mashup
⌵ ⌵ ⌵ ⌵

RHQ

- [Project Landing Page](#)
- [Project Documentation](#)
- [Release Notes](#)

What's new?

- > Versioned Deployments
- > Enhanced Remote Agent Installation
- > Bundle support for AS7/EAP6 domain mode

Alerted or Unavailable Resources
⌵ ⌵ ⌵ ⌵

Total: 1

Resource	Ancestry	Alerts	Availability
EAP server-three	EAP Domain Controller (master 0.0.0.0:8990) < last-rhq-agent.bc.jonqe.lab.eng.bos.redhat.com	0	⊘

Recent Operations
⌵ ⌵ ⌵ ⌵

Matching Rows: 43 (selected: 0)

Date Submitted	Operation	Requestor	Status	Resource	Ancestry
Nov 11, 2014 4:15:30 PM	Restart	rhqadmin	✔	EAP (0.0.0.0:10090)	last-rhq-agent.bc.jonqe.lab.eng.bos.redhat.com
Nov 11, 2014 4:11:20 PM	Get Current Date/Time	rhqadmin	✔	RHQ Agent	last-rhq-agent.bc.jonqe.lab.eng.bos.redhat.com
Nov 11, 2014 4:11:00 PM	Execute Availability Scan	rhqadmin	✔	RHQ Agent	last-rhq-agent.bc.jonqe.lab.eng.bos.redhat.com
Nov 11, 2014 4:10:51 PM	View Process List	rhqadmin	✔	last-rhq-agent.bc.jonqe.lab.eng.bos.redhat.com	last-rhq-agent.bc.jonqe.lab.eng.bos.redhat.com
Nov 11, 2014 4:10:51 PM	View Process List	rhqadmin	✔	last-rhq-server.bc.jonqe.lab.eng.bos.redhat.com	last-rhq-server.bc.jonqe.lab.eng.bos.redhat.com

Delete | Force Delete | Cancel

Resource Metric Graph - [last-rhq-server.bc.jonqe.lab.eng.bos.redhat.com](#)
⌵ ⌵ ⌵ ⌵

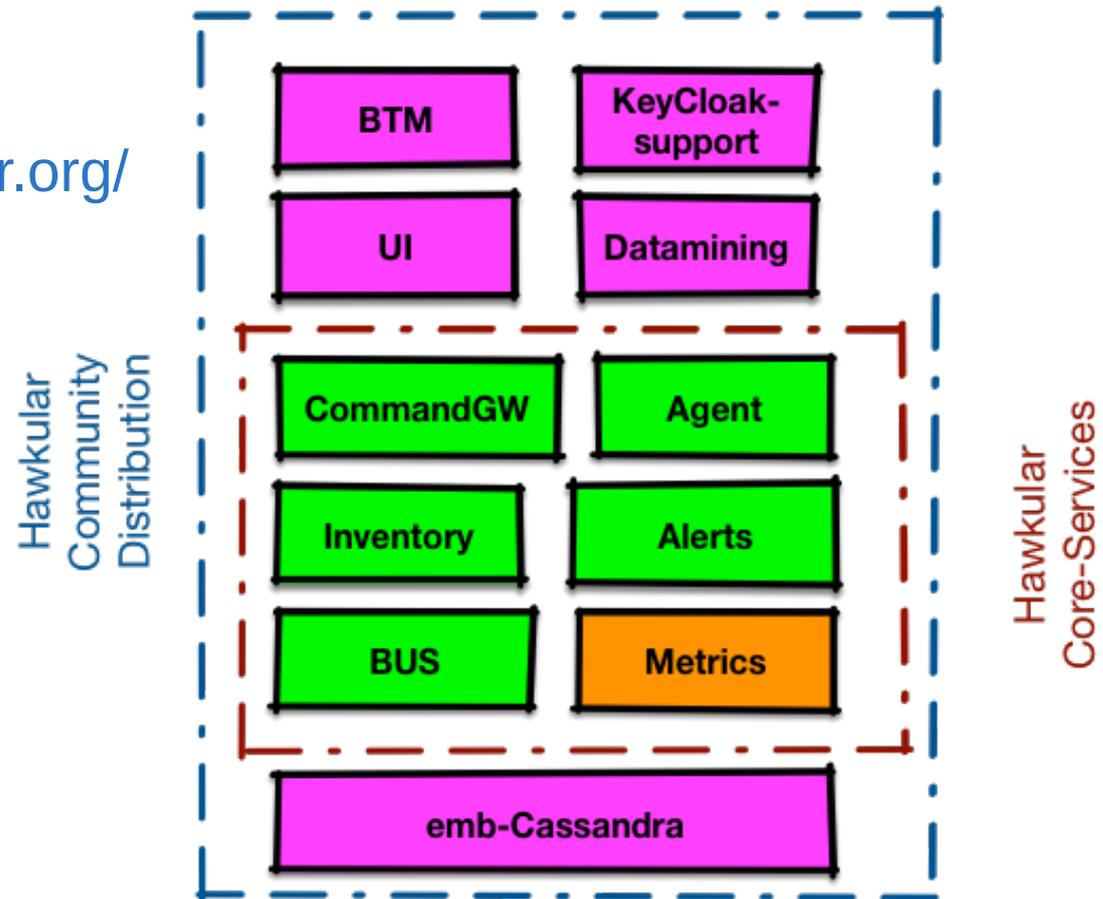
last-rhq-server.bc.jonqe.lab.eng.bos.redhat.com - Actual Free Memory



Hawkular

- Successor of RHQ
 - Set of independent services sharing information over a communication bus

- <http://www.hawkular.org/>



Openshift

- Cloud vs standard deployment model
 - PaaS
 - Cattle vs pets
 - DevOps
- Containers
 - Docker
- Kubernetes
- UI Demo
- <https://www.openshift.com/>



Thank you for your attention.
Questions?

